



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application of  
**Cook et al.**

Serial No.: 10/647,420

Filed: August 25, 2003

For: **A Method and Apparatus to Control  
Waste Toner Collection in an Image  
Forming Apparatus**

Attorney's Docket No: 2002-0848.02/4670-  
178

**Patent Pending**

Examiner: Mr. William J. Royer

Group Art Unit: 2852

Raleigh, North Carolina  
August 1, 2005

Mail Stop Amendment  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**DECLARATION OF PRIOR INVENTION UNDER 37 C.F.R 1.131**

We, William Paul Cook, Tom E Stickler, Larry Steven Foster, and David Erwin Rennick, inventors of the subject matter claimed in the above referenced application, hereby declare as follows:

1) We conceived an invention tentatively entitled "Waste Toner Handling," and prepared with due diligence an Invention Disclosure describing our invention not later than 14 April 2003. A partially redacted copy of the Invention Disclosure Addendum is attached as Exhibit 1.

2) We submitted the Invention Disclosure Addendum to the Lexmark Intellectual Property Law Department on 14 April 2003. Thereafter, we were contacted by the Intellectual Property Law Department and/or outside counsel that a United States

Patent application was to be prepared for this invention. This process included reviewing a draft copy of the application. We received a final copy of the patent application, which we reviewed, signed, and submitted to the Intellectual Property Law Department and/or outside counsel on 21 August 2003.

3) We were informed that the application was filed in the United States Patent and Trademark Office on 25 August 2003.

We hereby declare that all statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true, and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under §1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Aug 2, 2005  
Date

William Paul Cook  
William Paul Cook

11 AUG 2005  
Date

Tom E Stickler  
Tom E Stickler

AUG 2, 2005  
Date

Larry Steven Foster  
Larry Steven Foster

AUG 9, 2005  
Date

David Erwin Rennick  
David Erwin Rennick

**Go to Technical Evaluation**

**Print**

**LEXMARK**

Disclosure Number: 2002-0848.00  
Date Received: 04/14/2003  
Docket Number: 2002-0848.02

[illegible]

### Title of the Invention

**Product Code Name**

Reason for Addendum

## Summary

**Attorney: John McArdle**

Signature of Inventor	Date
Tom E. Sticksler	14 APRIL 2003
Harold E. Kram	14 APR 2003
<del>James S. Cook</del>	<del>15 APR 2003</del>
William Cook	4/15/03

Signature of Inventor	Date
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Signature of Witness Raymond J. Barry Date 4-15-03

Signature of Witness Connie B. Clarke Date 4/16/03

**Lexmark Confidential**

EXHIBIT 1

<https://knetus1.place.lexmark.com/us/invdisc.nsf/c682868784eaa752852568.../4859794758397f5985256d080052fdd5?OpenDocument> 4/14/03

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**LEXMARK CONFIDENTIAL**  
(When Completed)

**Invention Disclosure**

Full Name(s) of Inventor(s)	Emp. Serial	Div./Dep	Bldg. Zip	Location	Extension	FOR USE BY THE INTELLECTUAL PROPERTY LAW DEPT.
William Paul Cook	909341	A48L	035-2	LEX	2-6615	DISCLOSURE NO.
Tom E Stickler	369179	A43L	035-1	LEX	2-7787	Where & When Received (TIME STAMP)
Larry Steven Foster	768082	A35L	035-2	LEX	2-7564	
David Erwin Rennick	803423	A49L	035-2	LEX	2-4701	

**Title of Invention (Short and Descriptive)**

**Waste Toner Handling**

**Problem Solved by this Invention (Summary)**

A common waste toner handling system in an EP printer requires a means to move the toner from the cleaner blade on the photoconductor roll to a waste container, a means of spreading the toner throughout the container, as well as a means of detecting when the waste container is full. Novel means of spreading the waste, sensing the presence of the waste container and sensing a near full and completely full condition are disclosed.

**INVENTION BACKGROUND**

The capability of moving toner along a path using an auger is well known, as it takes advantage of the fluid flow properties of the toner. The waste material (toner, paper dust, etc.) may simply be pushed into an output container using the auger and/or gravity. If the output container is an integral part of the developer supply cartridge, it may not be necessary to pack the container efficiently or sense that the container is full, as a new cartridge will be installed when the fresh toner is depleted. However, the developer supply volume is greatly increased to accommodate the waste material, making the overall printer volume increase as well.

In a full color printer with several developers, a better solution is to provide a common container for the toner waste from all cartridges, and make the container a replaceable unit. In that case, it is necessary to pack the toner efficiently in the container and sense when the container is full. It would be optimal if a near full condition could be detected, to provide a warning to the user that the container will need to be replaced soon.

A simple design would utilize a separate motor on the waste container to spread and pack the toner, and a sensor of some type to detect the toner level within the container, such as an optical sensor.

<b>Witnesses: The two witnesses whose signatures appear below have read and understand this entire invention disclosure.</b>		<b>DISCLOSURE SUBMITTED BY</b>	
Signature of Witness <i>Raymond J. Barr</i>	Date 4-15-03	Inventor's Signature <i>Tom E. Stickler</i>	Date 14 APR 03
Signature of Witness <i>Cyrus B. Clarke</i>	Date 4/16/03	Inventor's Signature <i>David E. Rennick</i>	Date 14 APR 03
		Inventor's Signature <i>Larry S. Foster</i>	Date 15 APR 03
		Inventor's Signature <i>William Cook</i>	Date 4/15/03
		Inventor's Signature	Date
		Inventor's Signature	Date

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INVENTION DESCRIPTION

The waste toner is driven through the cleaner assembly by an auger (not shown) to a port on the waste toner chute. A vertical auger within the chute drives the toner down to the waste toner container. An existing motor is used to auger the toner down from the four cartridges to the waste container and spread the toner within the container. The existing motor normally drives the align roller in the paper path below (before) the development stations. The align roller uses established technology to align the leading media edge by running in a reverse direction while the leading edge enters the roller nip to generate a slight bubble in the media, then running in the forward direction to push the media into the first development station. The forward movement of the align roller is critical to image registration on the media.

A toner rake is also shown, which is capable of spreading the toner evenly throughout the waste container. One end of the rake is attached off-center to a rotating gear, providing an oscillatory raking movement. The torque needed to move the toner within the waste container varies with the amount of toner. At first, very little is needed, as the toner simply falls through the rake to the bottom of the container. As the waste pile size increases, it reaches the rake, and the rake pushes the top of the pile toward the empty container volume. Very little torque is needed at the top of the stroke of the rake, as the rake should not touch the toner pile. A little more torque is required during the active rake motion as it pushes the pile, but the difference is not enough to sense consistently. Eventually the empty volume below the rake becomes filled with waste toner, and the rake begins compressing the toner during its forward motion, while pulling a little toner back during the reverse motion. The torque increases significantly during the forward motion, and can be detected consistently as a near-full condition. Finally, the waste toner level rises above the rake, and the motor torque increases during the entire movement, while the forward torque becomes very large as the rake pushes through compacted toner. This condition is also detectable as a separate full condition. The sensing means is a simple comparison of the necessary PWM output that controls the motor. A small PWM percentage is needed to turn the off-center gear at first, and larger values are needed as the container fills up. The PWM value when the container is empty is saved in engine memory for comparison with later values. The maximum and minimum PWM values during one raking cycle are both used to generate the near-full and full conditions.

Toner is received from the four cleaner assemblies, which contain internal augers to drive the toner Toner falls down a port to a vertical auger (spiral conveyor) which drives the toner down to the waste collection container. A flexible flap, fixed at the top of each port, is agitated during each rotation of the auger, as the flap extends slightly into the shaft containing the auger. The resulting vibration keeps toner from sticking within the port. A spring-actuated shutter seals each toner entry port. The cleaner assembly pushes the entry shutter open when present in the printing position.

<b>Witnesses:</b> The two witnesses whose signatures appear below have read and understand this entire invention disclosure.		<b>DISCLOSURE SUBMITTED BY</b>	
Signature of Witness	Date	Inventor's Signature	Date
<i>Raymond J. Barry</i>	4-15-03	<i>John E. Stutler</i>	14 APR 03
Signature of Witness	Date	Inventor's Signature	Date
<i>Cyrus B. Clarke</i>	4/16/03	<i>John P. E. Kern</i>	14 APR 03
		Inventor's Signature	Date
		<i>James J. [illegible]</i>	15 APR 03
		Inventor's Signature	Date
		<i>William Cook</i>	4/15/03
		Inventor's Signature	Date
		Inventor's Signature	Date

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Because the torque to push the rake becomes large when the waste container is full, and because the torque varies significantly during each raking cycle, the rake movement is isolated from the align roll forward movement. A one-way clutch, [REDACTED] allows the rake to remain stationary while the paper is pushed up through the development stations, but engages and rakes the toner when the align roll is running in reverse. The reverse movement occurs during each gap, but the actual travel distance is very small, not providing enough raking action to distribute the toner evenly. Additional raking action is provided during run-in and run-out (media movement from the input stack to the align roll, and from the development stations to the output stack, respectively) and during transfer servo operations which extend the inter-page gap. The waste container level can only be tested while the rake is in operation, so it can only be checked at run-in, run-out, or extended gap periods. The vertical auger that pulls the toner down from the four cleaners is not isolated; it runs continuously with the align motor in both directions.

The waste container, [REDACTED] must be removed by the user when it is full and replaced with a new, empty one. The container must be present for the printer to operate correctly, so the presence of the container itself must be detected, as well. [REDACTED]

[REDACTED] A similar torque sense system (PWM value at fixed motor speed) is used to sense that the container has been removed. The rake interlock arm rotates when the container is removed, and engages a tooth on the rake drive gear, locking the gear into a fixed position. The motor will immediately stall, if it is running in reverse, and cause a high torque condition with no motor movement. The lack of motor movement, rather than the PWM value is used as a container presence sensing condition. Note that the container may be removed at any time without damage to the machine, or even difficult paper jams. The forward movement of the align roll is not impeded, so the media within the paper path can be driven to the output bin. The next sheet which was driven into the align roll will probably need to be removed and possibly returned to the input stack for operation to continue. When the waste box is absent, the exit port of the vertical toner chute is sealed by rotation of the rake interlock arm.

Witnesses: The two witnesses whose signatures appear below have read and understand this entire invention disclosure.

Signature of Witness	Date
<i>Raymond J. Bay</i>	4-15-03
Signature of Witness	Date
<i>Cyrus B. Clarke</i>	4/16/03

DISCLOSURE SUBMITTED BY

Inventor's Signature	Date
<i>Tom E. Stuchler</i>	14 APR 03
Inventor's Signature	Date
<i>David E. [illegible]</i>	14 APR 03
Inventor's Signature	Date
<i>[illegible]</i>	15 APR 03
Inventor's Signature	Date
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